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Keeping Track of Hawaii's Rare Flora

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". . . the presence of botanic records makes a botanic garden a Botanic Garden"
Peter Wyse Jackson

The value of a botanic garden rests on accurate documentation. The National Tropical Botanical Garden (NTBG) relies on detailed provenance information from its field collectors to track its Hawaiian flora. Approximately 1,000 species of plants are known to be native to Hawai'i, with as many as 89 percent occurring nowhere else. Unfortunately, this rich diversity of species is seriously threatened and the Hawaiian Islands face an extinction crisis unparalleled elsewhere in the United States.

Extensive botanical surveys conducted by the National Tropical Botanical Garden since 1989 have resulted in the collection and documentation of more than 1,737 accessions representing 700 native Hawaiian taxa, including 241 rare and 130 endangered taxa. The NTBG has made significant finds of 20 new, undescribed native plant species and 12 species believed to have been extinct. Comprehensive, broad-based, propagation research has resulted in determining propagation methods for 358 taxa, the majority of which have never been cultivated before. These include 102 endangered or proposed taxa and 62 candidate species. The need to explore, document, collect, and grow Hawaiian plants increases each year as more plants approach the brink of extinction.

Continued on page 23

In This Issue

Keeping Track of Hawaii's Rare Flora *by Melany Chapin* 21

Notes on the Decline Problem of Koa *by Donald E. Gardner* 27

Native Vegetation Invades Old Sugarcane Fields on Hawai'i *by Grant Gerrish* 32

Try Cultivating Our Native Hawaiian Flora *by John Obata* 36

Note From the Editor 36

Spring Fundraisers *by Camille Barr* 37

Science Fair Winners Send Thanks and Abstracts 38

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Continued from page 21

The National Tropical Botanical Garden has designed a collection form adapted from The Nature Conservancy of Hawai'i for provenance records of native Hawaiian plants. The Hawaiian plants database was developed in dBase III and follows this form. There are additional fields related to the living collections, such as the number of plants planted out and their location in the garden.

A provenance report can easily be generated after data entry. This report accompanies plants or seeds when they are distributed to the nursery, to collaborators, or elsewhere. These assist the nursery manager in determining the plant's growing requirements, based on habitat, aspect, and soil. They are also useful to visiting scientists and colleagues studying specific plant groups or conducting other research.

The minimum requirement for each record is the information needed to trace the origin of the plant. This includes the plant name, the collector's name and number, the date, and the precise locality of the collection. In this way, there are five references to identify the collection if there is human error. If only one determinant is used, such as the accession number, there may not be enough information to track the plant record when an error occurs in transcribing the number. The collector's name and number are also used to refer to the voucher specimen.

The value of a botanic garden rests on accurate documentation.

A collection's value drops significantly without location information. The more information included, the better. The United States Geographical Service quadrant maps provide excellent references for topographical features, elevation, and location within the United States. The accuracy and type of information collectors gather for location depends largely on the instruments available and the accuracy, calibration, and proper use of that equipment. Another consideration is that even if the most sophisticated technology is used to gather location data, that same equipment will be necessary to relocate the plant again. Basic information such as elevation, directions given from fixed features, natural feature references, and longitude and latitude all contribute to accurate site location.

The next set of information needed is the International Transfer Format (ITF) information. This includes the following:

a) *File Identification data.* Internal information about the arrangement of the data that will follow.

b) *Accession data.* The unique identifiers assigned by the garden to each plant.

c) Plant name. The full scientific (Latin) name of the plant, identified as accurately as possible.

d) Verification data. A set of fields to indicate the degree of confidence which may be placed in

the identification of the plant's name.

e) *Sexuality.* The sex of the plant accession.

f) *Source data.* How the plant was obtained and how it has since been propagated.

g) *Place of origin.* Where the plant came from, with supporting data, such as altitude, if of wild origin.

h) *Conservation data.* The degree of threat to the taxon in the wild. (This is included so that IUCN Threatened Plants Unit can add the conservation category into the data files of individual gardens, rather than the categories being assigned by garden staff). Global status will be specified by international, national, or state authorities. Management status may designate the actual status of a taxon which may not currently be reflected in global status records, and may be assigned by Garden staff or other qualified individuals.

Plant propagules are assigned accession numbers upon receipt at NTBG. Accessions at NTBG are six digit numbers. The first two designate the year the collection was received by the institution. The last four are sequential numbers in the order that the collections were received. For example, with the number 940232, the year is 1994, and this was the 232nd accession received. This number continues until the first day of January the next year in which a new number designating the year is used and the first number begins with 0001. For example, 950001 would be the first accession of 1995.

Recollections are handled as new accessions. This is important since the genetic composition will be different for each seed lot. In reduced, threatened, or rare populations with 25 or fewer individuals in the wild, each plant is tagged in the field with an inconspicuous, permanent tag. It includes the collector's name, a unique collection number, the date, and the institution's initials. Any past collections made from these plants or the population are also referenced in the collection records.

Each plant receives a unique plant number when it is ready to enter the living collections. At NTBG this is a three digit, sequential number. Every plant number starts with 001 for each accession. For example, ten seeds of *Brighamia rockii* may be propagated into potted seedlings. Each plant randomly receives a plant number from 1 to 10. This number follows the six digit accession number and a decimal. It is included on the permanent tag accompanying the plant into the living collections. For example, 940232.005, is plant number five of the accession 940232.

The status of the individual plants, the population, and plant community are helpful for conservation purposes. This kind of information is needed to define goals and procedures in collecting, propagating, studying, and distributing rare plants. Even if a species is not currently at risk, this information will help in future work for understanding the rate of its decline or

the status of its health as a wild population.

An important observation in the field is the condition of the plant. Is it healthy, declining, senescent, or dead? What is its height? Other indicators of the viability of the population to record include the age structure of the population, number of seedlings, immature, mature, or senescent individuals. This may seem irrelevant for a collection, but it indicates if the population is reproducing in the wild and how successfully it is doing this.

Noticing if the plants were in leaf, or had buds, flowers, immature fruits, mature fruits, or were dormant is important. This may be a clue to possible pollination problems, insect pests, or other threats. Plant phenology may also indicate why cuttings were taken as opposed to seed. For example, some Hawaiian species have never been known to flower or set viable seed.

Habitat information is exceedingly helpful to the propagator and for understanding the status of the population. Important data may include the type of substrate, such as the soil, rock, or humus where the plant was found growing. What aspect does the plant have to the sun? How much sun or shade does it receive? Is it found on the top of a ridge, the middle of a slope, on a flat area, or a vertical cliff? What associated species were found growing with it? It is important here to generate more than just a species list, but quantitative information such as the dominant species found occurring, the estimated amount of invasion from weeds, etc.

Other helpful information that can be answered on a collection form with just a simple check includes the habit, frequency, the documentation of the plant by a photo, or a voucher specimen. The names of observers on the expedition can be beneficial if further information is required.

Consistency is important in plant record keeping. Above all, sharing this information with collaborators helps conservation work and it may reduce duplicate efforts.

Developments in computer hardware and software are rapidly being made. As we are moving into an era of multimedia, not only can text and images be incorporated into an information system, but sound and video. With this in mind, The National Tropical Botanical Garden is considering the upgradability and cross platform capabilities of the computer systems used for accessioning and mapping. This means programs that can run on Unix systems, MacIntosh computers as well as computers with DOS, OS2, or other operating systems. It is now possible with the advent of the Power PC to run MacIntosh and Windows applications on the same computer.

Since hardware and software are constantly changing and information systems are rapidly advancing, it is important not to hamstring ourselves with a database design restricted to just text. It is quite feasible to design a system that can take advantage of the imaging capabilities, the multimedia advances and the audio techniques that are

ready to be accessed at this time. This may sound as if it is not necessary at this time, but that is only from the point of view of exchange of information in a text mode such as books and literature. Current and future computer technology allows us to transmit knowledge more than in a purely textual format. It has been determined that the future of information sharing will include text, images, audio, and dynamic media such as quick-time movies, seamlessly transported across as many platforms and as many systems as possible with as little effort as possible.

When imaging is considered, storage capability needs to be taken into account. Fortunately, storage capacity is becoming more and more affordable, not only in hardware forms, such as hard drives with multiple gigabytes of memory and CD ROM, but in remote forms as well. With communication companies improving their fiber optic linkages, and high speed digital switching, data can be stored remotely and quickly. It can also be accessed through high-speed data lines.

Like most botanical gardens, NTBG needs to get as much mileage out of their investments in hardware and software as possible. The direction information technology is heading gives us some guidelines for the choices we make today. It is essential to design a database system for a botanical garden with these things in mind.

We do not need to be computer analysts to be botanists. Remember that the computer is only a tool. The science of plants will accelerate with the use of computers, but the value of that information is only as good as the accuracy of the scientists behind it. Similarly, programs that are user-friendly are a priority. The last thing any garden wants is the idea that data retrieval is dependent on one person who has the skill to access it. An undesirable scenario is when a record is needed and the response is, ". . . Joe's the only one who can do that and he's on vacation until next week." This is where the choice of software should include a learning program that enables several staff members to cross-train in the major operations of that program.

People involved with botanic gardens usually harbor a deep appreciation of plants and the environment. Unfortunately, this often means that sitting at a computer, or doing record keeping may be unattractive. NTBG staff member Steve Perlman once said, "a bad day in the field is better than a good day in the office." However, all the time and effort spent in the field, often in cliff-hanging situations, carefully collecting valuable seeds of rare plants, loses its value without precise, detailed records. To preserve and make full use of living collections, good provenance records must accompany all plant collections.

Notes on the Decline Problem of Koa

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Koa (*Acacia koa*) is among the most important components of Hawai'i's native flora from the standpoint of its ecological, cultural, and economic significance. A decline of koa has been evident for some time where this tree forms the dominant overstory vegetation type in Hawaiian forests. In 1972 F. F. Laemmlen, then a University of Hawai'i plant pathologist who devoted some research effort to native forest diseases, and R. V. Bega, a forest pathologist with the U.S. Forest Service, reported that in surveys in 1954, 67,000 acres of koa and 'ōhi'a (*Metrosideros polymorpha*) forests occupying approximately 600,000 acres on the island of Hawai'i were found to be in slight to severe decline (Laemmlen and Bega, 1972). Slight decline was defined as a condition with less than 20% dead trees, whereas severe decline was indicated by 60% or more dead trees. In 1965, the affected areas had increased by 10,000 acres, and the severely affected portion reportedly had increased from 5,000 acres (in 1954) to 14,000. The decline was characterized as a rapid wilt and death of trees and/or a slow progressive decline causing a thinning of foliage with many dead twigs, followed eventually by complete defoliation and death. Laemmlen and Bega mentioned several possible causal or contributing biotic agents, including the fungi *Armillaria mellea, Phytophthora cinnamomi*, and *Diatrype princeps,* the insects *Xylosandrus compactus* and *Plagithmysus bilineatus,* and the activities of wild pigs and other mammals (presumably rats). Abiotic factors such as changes in soil drainage were also suggested as being possibly involved (Laemmlen and Bega, 1972). Although Laemmlen and Bega concluded that quantitative and qualitative studies of the decline had been initiated, I am not aware of the results of such a study if, in fact, one was conducted.

In the late 1970s and 1980s, I, together with park resource managers, became aware of a number of sites where koa was dying in the Mauna Loa Strip area of Hawai'i Volcanoes National Park (HAVO). At sites in mature stands, groups of standing or fallen dead trees in roughly circular areas were surrounded by live, apparently unaffected trees, suggesting that the decline was no longer spreading. At other sites, stands of younger trees which recently had been

vigorous and healthy, were in various stages of decline and death. One such area which was particularly easily observed was located adjacent to Kīpukapuaulu and the Mauna Loa Strip road. In this area, numerous less-than-mature trees, including saplings 1-2 m tall, declined rapidly, progressing from an apparent healthy condition to a general light green, then yellowing of the foliage, and death of the plant. Dead trees were frequently observed with phyllodes still attached, indicating a rapid decline.

Early observations indicated that declining trees at the Kīpukapuaulu site often contained one to several brooms of the koa rust fungus, and casual observers usually attributed the decline to the rust disease. However, my further observations indicated that the rapid decline occurred also at other more or less well-defined sites (e.g., the former location of the weather station at approximately 5,600 ft. [1,707 m]) where young, recently vigorous trees also showed striking symptoms of the quick-decline. Incidence of rust disease at this site was relatively low and did not appear to account for the decline. Furthermore, subsequent studies of the koa rust fungi suggested that, whereas death of entire trees was sometimes associated with one of the rust species (*Endoraecium acaciae*), this fungus typically produces large, conspicuous witches' brooms in infected trees and is easily identified. Other rust fungi kill distal portions of individual infected twigs or limbs rather than causing rapid, uniform decline of the infected tree (Hodges and Gardner, 1984).

...any suggestion of a koa decline epidemic, with a single cause, may be premature.

I also reported a seedling wilt disease of koa associated with a fungus, *Fusarium oxysporum*, which was shown to be seed borne (Gardner, 1980). Seeds collected from a number of locations within HAVO as well as from open forests on the slopes of Mauna Kea, when germinated and grown under favorable temperatures, resulted in infection and irreversible seedling wilt. The fungus was isolated from diseased plants and its pathogenicity demonstrated in inoculation tests with healthy seedlings. The fungus was reported as a new member of a well-known group of "vascular wilt" fungi, characterized by their high degree of virulence and host-specificity, often being limited to a single species, or to a small number of closely related species within a genus. As their name indicates, these fungi enter the host from the soil through the roots and systemically invade the xylem tissue of the root and shoot, disrupting the flow of water and causing a rapid, irreversible wilt. During the active developmental phase of the disease, particularly in older woody plants, the fungus itself is contained internally within the host and no external signs or symptoms are apparent except the persistent wilting. A fungus resembling the one causing seedling wilt was isolated, al-

though with less consistency, from declining older trees in the field sites (Gardner, 1980). *Fusarium* wilt diseases typically are virulent to all developmental stages of the host, from seedlings to mature plants. Therefore, the possibility that this disease could account for koa decline, at least in part, was considered (Gardner, 1980), and is still being investigated. Several questions regarding the *Fusarium* disease still remain, including whether the fungus is native or introduced (a factor which is often difficult to prove with fungi, but the former seems more likely), how the fungus becomes associated with the seed, and how it is dispersed (i.e., the disease cycle). The only practical control for most vascular wilt diseases in agricultural settings, where they have caused major crop losses, is by development of resistant varieties.

Other diseases reported on koa which may logically be considered in a discussion of the decline phenomenon, in addition to the root rot caused by *A. mellea* mentioned above, include heart and root rots associated with the wood-rotting fungi *Phaeolus schweinitzi*, *Polyporus sulphureus*, *Pleurotus ostreatus,* and *Ganoderma* sp. (Bega, 1979). These diseases were suggested as major contributors to the deterioration of old-growth koa stands in Hawai'i. However, these would not appear to account for the decline of young, vigorous trees. Likewise, the wood-rotting fungus *Phellinus kawakamii*, recently described as a new species attacking both koa and *Casuarina equisetifolia* (Larsen et al., 1985), occurs on mature trees and does not appear to be involved in the decline described here. Most of the above fungi produce conspicuous external fruiting bodies which enable their recognition and identification. Both of the fungi *Hypoxylon annulatum* and *Xylaria rhopaloides* have been reported on koa (Stevens, 1925). These species are members of genera usually characterized as weakly parasitic or saprophytic on woody plants, and their involvement in koa decline is doubtful, although I am not aware of any attempt to assess this directly.

The ubiquitous root rotting fungus *Phytophthora cinnamomi*, which had been implicated in koa decline by Laemmlen and Bega (1972), was later tested for its pathogenicity to a number of endemic and alien forest plants (Kliejunas, 1979). The results placed koa in a category of species considered "moderately tolerant" to the fungus, indicating that root rot caused by this fungus is not a likely major factor in koa decline. Other diseases of koa reported include collar rot, (Aragaki et al., 1972) and shoot blight (Nishijima and Aragaki, 1975) caused by the fungi *Calonectria crotalariae*, and *C. theae*, respectively. Incidence of collar rot appeared to be a one-time epidemic following the favorable effects of a recent forest fire in allowing dormant koa seeds to germinate and form an even-aged stand of seedlings. Fungal growth and red fruiting bodies were evident above the soil line of infected plants. Shoot blight on older shoots was characterized by brown-

gray spots accompanied by leaf drop, but seedlings inoculated with the pathogen wilted quickly. The authors noted that shoot blights of ʻōhiʻa and koa have been encountered only infrequently in Hawaiian forests and do not seem to be of much consequence.

...it is not possible to rule out possible contributions from the other disease, insect, and abiotic factors...

The influence of insects on koa appears quite well documented. Most such effects are readily apparent as feeding damage, defoliation, as caused by the endemic koa moth *Scolorythra paludicola* (which is usually followed by refoliation) (Stein and Scowcroft, 1984), and the presence of the insects themselves on the host. The introduced koa psyllid, *Psylla uncatoides,* has been noted to cause serious feeding damage to young koa shoots, but such damage is readily identifiable because of the high concentration of associated insects (Leeper and Beardsley, 1976). Stripping of koa bark by rats also has been reported to have a deleterious effect on koa (Scowcroft and Sakai, 1984). This predation apparently was limited to the tender bark of saplings. Trees are usually not completely girdled and therefore do not die quickly, but the bark removal weakens and distorts the trees and allows entry by pathogens which can have secondary effects.

In 1994 the death of a mature koa tree on a homeowner's property on Mt. Tantalus, Oʻahu, and apparent progressive decline among similar nearby trees, were brought to my attention and that of the State Department of Agriculture (DOA). We isolated *F. oxysporum* from branch sections which had been recently cut from the dead tree. An NSF Young Scholars student, Erin Yoshino, and I demonstrated the pathogenicity of this fungus in inoculation tests on koa seedlings, providing evidence for this fungus as the cause of death of the Tantalus tree (unpubl. report). I am aware of other unpublished accounts of dead or dying koa trees from other sites on Oʻahu, but at present have no data to indicate whether this phenomenon is increasing, or whether the same or similar symptoms are involved in each case. Therefore any suggestion of a koa decline epidemic, with a single cause, may be premature. I am continuing, with my research assistant, Rob Anderson, to investigate the recovery of *Fusarium* from tissue of diseased trees in the field. In any case, because of the characteristic high degree of host specificity of vascular wilt diseases, the widespread general decline of both ʻōhiʻa and koa reported by Laemmlen and Bega (1972) could not be completely accounted for by this disease. At present it is not possible to rule out possible contributions from the other disease, insect, and abiotic factors mentioned.

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Native Vegetation Invades Old Sugarcane Fields on Hawai'i

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Introduction

To date, botanical literature has not shown native Hawaiian plants to be participants in secondary succession on abandoned fields and efforts to protect native biota start with the assumption that lowland agricultural lands are lost habitat. The pseudoscientific myth that island species are inherently weak competitors has been promulgated from Darwin (1859) to Carlquist (1965). Although a countercurrent has long existed that the native biota would eventually re-establish itself (Egler 1942, and others), abandoned fields at low elevations appear to be so firmly in the grip of alien species that texts on the management of native ecosystem do not even mention this vegetation zone or secondary succession (e.g. Stone and Scott 1985). The research synthesis volume, *Island Ecosystems* (Mueller-Dombois et al 1981), indexes 'sugarcane' and 'secondary succession' each one time only. However, an assessment of the probable fate of the native biota, based for the first time on integrated research, appears in this text. Mueller-Dombois writes (pp 515-517) that native plants, all descendants of colonizing species, cannot be dismissed as weak competitors and will not be easily displaced, and, furthermore, many of the alien species so conspicuous in secondary succession today may be of only temporary importance. Observations supporting this conclusion are here reported.

The lowland wet forests of Hawai'i have been nearly eliminated by intensive, large-scale agriculture. Sugarcane cultivation reached a peak in the 1970s. (See Cuddihy and Stone [1990:41-43] for the history of the sugar industry in Hawai'i.) However, in the last 20 years, commercial sugar production on Hawai'i has disappeared with the closure of the plantations in Kau, Puna, North and South Hilo, Hāmākua and North Kohala. Not all of the abandoned cane fields have been converted to other uses.

Field Observations

Secondary succession on abandoned cane fields begins with a volunteer stand of sugarcane (*Saccharum officinarum*) that become progressively invaded and displaced by alien grasses, sometimes followed by shrubs and fast-growing trees. In a few localities, seral communities dominated by the endemic 'ōhi'a (*Metrosideros polymorpha*) and indigenous uluhe (*Dicranopteris linearis*), similar to nearby

early-primary succession communities, are displacing the alien grasses. Endemic koa (*Acacia koa*) and neneleau (*Rhus sandwicensis*) are also invading some old fields.

The best-developed native vegetation that I have observed on old cane fields is in the Kaūmana Homesteads on the outskirts of Hilo between 350 and 450 meters elevation. Here an ʻōhiʻa/uluhe community covers almost half of a 40 hectare site of cane field abandoned around 1970. Within the extensive patches of native vegetation the ground cover is nearly 100% uluhe, ʻōhiʻa saplings form an open canopy up to ten meters high, and there are abundant ʻōhiʻa seedlings less than 3 m tall. A couple of other native ferns and herbs can also be found, adding to a community similar in species composition and vegetation composition to the primary pioneer vegetation on nearby lava flows. In 1992 and 1995 I made detailed observations along a staked survey line that confirm that this is a seral community that actively displaces the old-field pioneer grass community.

That pioneer community, which covers the remainder of this Kaūmana site, is dominated by alien plants, with a dense ground cover of torpedo grass (*Panicum repens*, locally called "Wainaku grass"), California grass (*Brachiaria mutica*), molasses grass (*Melinis minutiflora*) and others, including a remnant of volunteer sugarcane. The most common shrub is melastoma (*Melastoma candidum*) with scattered waiawī (*Psidium cattleienum*). Very widely scattered trees of albizzia (*Paraserianthes falcataria*) up to ten meters tall give this successional grassland a savanna appearance. Close inspection shows that ʻōhiʻa seedlings and small saplings can be found throughout the site. A few scattered koa trees occur in both the alien pioneer and the native seral communities. The tall albizzia trees, as well as scattered saplings, persist within the native seral community, as do melastoma and waiawī. The two latter shrubs are often covered by vigorous growth of uluhe.

I attribute the success of the native vegetation on this site to three factors – the passing of adequate time since the field was abandoned, the lack of post-abandonment disturbance such as cattle grazing, and, perhaps most important, abundant nearby seed source. This site is on a pocket of relatively deep ash soil (Hydrandept) between the 1881 lava flow and other shallow-soil (Tropofolist) areas that were never cleared for agriculture. Both of these areas are still dominated by ʻōhiʻa/uluhe fern forest as described as a community within the lowland wet forest (Gagne and Cuddihy 1990).

In 1992 I also observed ʻōhiʻa, koa and neneleau seedlings and saplings within abandoned cane fields of North Hilo district, in the land (ahupuaʻa) of Manawaiʻōpae above Laupāhoehoe. These native tree seedlings were becoming established within two years of field abandonment, but I did not find any extensive patches of uluhe ground cover, and therefore

no development of a vegetation dominated by native plants. Sugarcane was still the dominant species with guinea grass (*Panicum maximum*) and sensitive plant (*Mimosa pudica*) perhaps the most prominent invaders. The ʻōhiʻa and koa were seen primarily along the gulches and the forest reserve boundary at the upper elevation limit of the cane fields, near 550 feet elevation, again showing the importance of a nearby seed source. I have not observed invasion by native species in the interior of old cane fields of North Hilo and Hāmākua Districts. Guinea grass and ironwood (*Casuarina equisetitolia*) are among the most prominent pioneers throughout these districts.

Observations made in 1992 in Keaʻau, Puna District, found no establishment of ʻōhiʻa or koa and only a very minor presence of any native plants in cane fields abandoned in 1984. A botanical survey of a 900 hectare site between 60 and 230 meters elevation found pioneer alien grasslands rapidly giving way to a secondary forest of alien trees. The dominant grasses were California grass, broomsedge (*Andropogon virginicus*) and little bluestem (*Schizachyrium condensatum*). The dominant trees, all locally known as 'trash trees,' were melochia (*Melochia umbellata*), guarumo (*Cercropia obtusifolia*), gunpowder tree (*Trema orientalis*), Alexander palm (*Archontophoenix alexandrae*) and albizzia. Although this site abuts the Waiākea Forest Reserve, plantations of *Eucalyptus* spp. separate the site from native forest. This entire area appears to lack a seed source for native species. A 1996 drive-through inspection of this site also failed to find any re-establishment of native vegetation. However, established patches of ʻōhiʻa and uluhe were observed in 1996 in old cane fields at the eastern edge of the abandoned plantation, adjacent to the Hawaiian Acres Subdivision. This subdivision is largely vegetated by ʻōhiʻa/uluhe forest.

Conclusion

ʻŌhiʻa and uluhe are the Hawaiian representatives of *Metrosideros* and *Dicranopteris*, two highly successful genera of the Pacific region. In the Hawaiian Islands they are dominant species of primary succession and cyclicly regenerate following the dieback of forest stands (Mueller-Dombois 1992). Furthermore, these two species very frequently occur together in a wide range of community types and appear to have a functional relationship (Gerrish and Mueller-Dombois 1980). It should be no surprise that these, and other Hawaiian plants, insert themselves into the successional sequence on old fields in the wet lowlands. In the past most abandoned agricultural land was quickly converted to other human uses, preventing observation of natural old field succession.

Although tens of thousands of hectares of cane fields have recently been abandoned on Hawaiʻi, a relatively small proportion of these have been left undisturbed. However, it is probably possible to piece together a series of sites that represents a successional

chronosequence. In addition to the three controlling factors mentioned above, i.e. passage of time, post-abandonment disturbances, and proximity to seed sources, it is likely that substrate characteristics and the local flora affect the success of invading native species.

I would enjoy hearing other reports, especially from other islands, of reestablishment of native vegetation on agricultural lands.

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Try Cultivating Our Native Hawaiian Flora

John Obata

Forty years ago, it was not a noble adventure to propagate the native Hawaiian flora. One was often ridiculed for even trying. Today it is the in thing. How times have changed.

But which plants can one plant to enrich urban environs? In the sunny and drier lower elevation, urban Honolulu, the following is suggested for ease of culture:

Loulu palms (*Pritchardia* – all species) the only native palms.

Ground cover: ʻūlei (*Osteomeles*) pōhinahina (*Vitex*)

Small tree-bush: kūluʻi (*Nototrichium sandwicense*) ʻaʻaliʻi (*Dodonea viscosa*) nāʻū, nānū (*Gardenia brighamii*).

Small tree: alaheʻe (*Canthium odoratum*), naio (*Myoporum sandwicense*) Most hardy of them all. Grows under almost every condition. Hōʻawa (most *Pittosporum* species) Many species tend to be bushy.

Kūluʻi, nāʻū, and pōhinahina do not seem to thrive in a rather wet environment. The others seem to tolerate this situation. Natives require a lot of nitrogenous fertilizers to prevent chlorosis. Iron chelating compounds should solve this problem. Easier still, a lot of organic fertilizers, such as manure should suffice. With a heavy use of chemical fertilizers, the substrate cannot be completely dried out.

For best results, try growing plants in areas with good drainage and adequate wind movement, the more the better. If you want to venture out on your own, try growing plants whose origin is from the drier natural terrain. Happy planting!

In the next issue the more complicated issues will be addressed.

Note from the Editor

Although I have enjoyed editing this newsletter, I have decided to pursue other interests and goals. Another editor has been found, and I am sure he'll introduce himself to you in the next issue. I wish all members of the Hawaiian Botanical Society my warmest aloha.

Sincerely,

Gregory A Koob

Gregory A. Koob

Spring Fundraisers

July 12, 1996

This Spring the Botanical Society had a number of successful fundraisers which got a lot of people out and helping and raised a substantial amount of money. At the Earth Day festival at Kapi'olani Park on April 18, we had a plant and print sale which netted us $175. Great help was given by Dr. Bill Steiner, Alvin Yoshinaga, Robert Pattison, Mandy Heddle, and Vicki Caraway. Many thanks go to the artists who donated the amazing artwork – Dr. Francisca do Val, Dr. Rick Palmer, and Louise Barr – and to the various people who donated plants including Rob Anderson, Alvin Yoshinaga, Adrian Ares, and the UH Horticulture Society. There were nonstop streams of people admiring our booth and asking questions about Hawaiian native plants.

Our annual plant sale at our May meeting brought in $132. Thank you to all who brought and bought plants – there were some really beautiful specimens.

Our big fundraising push was the raffle for which we were lucky to have many businesses donate great prizes, and so many people help sell tickets. We raised $438 which was more than we expected! Mahalo to the businesses who donated prizes which are listed below:

Mahalo Air – two round-trip interisland air coupons

Patagonia – one polartec fleece, one fanny pack, and 4 hats

Canoes Restaurant – $50 gift certificate

Shipley's Alehouse and Grill – $25 gift certificate

Hawai'i Nature Center – three pairs of Nature Passes

Hawaiian Islands Tea Company – 28 boxes of great tea

Tim Motley and Winona Char – five Botany dept. t-shirts

Alvin Yoshinaga – one daypack and one puzzle

Because of the numbers of prizes we had, we were able to declare 48 people winners – good odds! In addition to the businesses, thanks to those who helped out, especially Rob Pattison, Alvin Yoshinaga, Wisteria Loeffler, and Ron Fenstemacher, and of course thanks to all those who sold and bought tickets.

Much of the money will go to covering past debts, however these include Science Fair prizes and the cost of our newsletter which are very worthy causes. It is hoped that the rest of the funds can be put to use benefiting the Hawaiian flora which is under constant threat. Clearly the job is not yet done, and we will need even more of you to participate in order to continue the great start we have gotten here.

Camille Barr
President

Science Fair Winners Send Thanks and Abstracts

Two winners of the Botanical Society Awards for projects displayed at the Science Fair sent in abstracts on their projects. One sent in a nice thank you letter. All are reproduced below.

Melanie Kim

Letter

Hawaii Botanical Society
c/o Ms. Camille Barr
Botany Dept. UHM
3190 Maile Way #101
Honolulu, Hawaii 96822
June 3, 1996

Dear Camille Barr,

First I'd like to say I am so sorry for taking so long to thank you for your generous prizes. I really hope you don't think I'm not grateful or careless. I was so pleased the Hawaii Botanical Society acknowledged my project among the many other great projects. For me, it was an honor just to participate in the 39th HSSEF, since this was my first time ever doing anything this exciting and committed. Thank you for the book entitled *La'au Hawaii – Traditional Hawaiian Uses of Plants*, I will have much use of it. Also for the t-shirt and the prize money. I am even more excited to be a member of the Hawaii Botanical Society, I have never really been recognized for something so special, so it means a lot to me. In the future, I would like to continue my research on Hawaii's native plants and the effect of all the elements involving them. I just wanted to express my gratitude for the effort you gave to have people interview the students at the fair. I'm glad there are people who actually care about the future of Hawaii.

Sincerely,

Melanie Kim

Abstract

Effect of Substrate Inclination on the Competition Between *A. koa* and Alien Flora Species

My project, the Effect of Substrate Inclination on the Competition Between *A. koa* and

Alien Flora Species, was done to find out what affect substrate inclination has on *A. koa*'s ability to compete with alien flora. I concluded that substrate inclination has a major affect on the difference in competition. The trees growing on inclined surfaces had little or no weeds around it compared to trees growing on horizontal surfaces which had numerous numbers and types of alien flora surrounding them. This was my original purpose; so for the District Fair I decided to discover what characteristics of the inclined substrate made the results vary. I concluded the reason the inclined substrate had so little flora is, because the weeds had a more complicated time reproducing. This is because growing up a hill is harder than just growing on a flat surface.

Bibliography

1) *Hawaiian Forest Plants* by Mark David Merlin. Copyright 1st edition 1976 – 2nd printing.

2) *Handbook of Hawaiian Weeds* by different references as authors - Copyrights vary also because of different references.

3) *Physical Science* by Gordon P. Johnson. Copyright 1984 by Addison-Wesley Publishing Company

Amy Shimabukuro

Title of Project: Roadside Biodiversity
School: Pahoa High School
Subject Category: Environmental

Abstract

Biodiversity is a "measure of the abundance of species of plants and animals in a given area." By picking two sites, one altered (bulldozed), the other old growth native forest, up in Volcano across from each other. I plan to compare the two sites for the biodiversity within each. By gathering data; collecting invertebrates, identifying plants, birds, and invertebrates, I should compile enough information to determine which site holds more biodiversity. Consequently, after compiling the plant, bird, and invertebrate data for each site (Natural, Altered) my hypothesis, "In an area of native ecosystem there should be a higher level of biodiversity than that of the altered site," is invalid due to similar results of the bird and invertebrate data of both sites.

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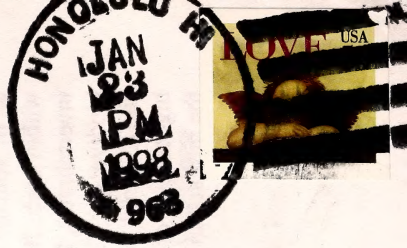

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